National Aeronautics and Space Administration

NASAfacts

The 18th Annual NASA Great Moonbuggy Race

Tomorrow's engineers carry on Apollo rovers' legacy of ingenuity

Huntsville Center for Technology student racers Ezra Logreira, left, and Karine Wittenborg are geared up for the 18th annual NASA Great Moonbuggy Race. (MSFC/David Higginbotham)

The 18th annual NASA Great Moonbuggy Race is set for April 1-2 at the U.S. Space & Rocket Center in Huntsville, Ala. Nearly 90 student teams will demonstrate the same ingenuity and can-do spirit that sent the first Apollo-era lunar rover rolling across the moon's surface 40 years ago.

The event challenges high school, college and university students to design, build and race lightweight, human-powered rovers -- "moonbuggies" -- which address many of the same engineering challenges dealt with by NASA's Apollo-era lunar rover developers in the late 1960s. The competition is designed to teach students to troubleshoot and solve problems -- and to interest them in pursuing future careers as engineers, scientists and space explorers.

Teams registered to compete in the 2011 race include students from 22 states and Puerto Rico; and international challengers from six countries, including returning teams from Canada, India and Germany and -- for the first time -- racers from Ethiopia, Pakistan and Russia. More than a quarter of all registered teams are new to the race in 2011.

The first NASA Lunar Roving Vehicle made its inaugural excursion on the moon's surface July 31, 1971, driven by Apollo 15 astronauts David Scott and James Irwin. Two more rovers followed in 1972, enabling still greater scientific exploration during the Apollo 16 and Apollo 17 missions.

Four decades later, teams competing in the NASA Great Moonbuggy Race strive to uphold

Registered 2011 high school teams

Academy of Arts, Career & Technology, Reno, Nev.
Arab High School (two teams), Arab, Ala.
Bob Jones High School, Huntsville, Ala.
Cape Girardeau Career Technology Center, Cape Girardeau, Mo.
Carlisle County High School, Bardwell, Ky.
Chambers County Career Technical Center, Lafayette, Ala.
Cookeville High School, Cookeville, Tenn.
Dooly County High School (two teams), Vienna, Ga.
East Chicago Central High School, East Chicago, Ind.
East Limestone High School, Athens, Ala.
Elk Valley High School, Longton, Kan.
Escuela Superior Urbana High School, Patillas, Puerto Rico
Fairhope High School (two teams), Fairhope, Ala
Fajardo Vocational High School, Rio Grande, Puerto Rico
Guntersville High School, Guntersville, Ala.
Huntsville Center for Technology (two teams), Huntsville, Ala.
International Space Education Institute, Leipzig, Germany
Isidro Sanchez High School, Luquillo, Puerto Rico
Jack Britt High School, Fayetteville, N.C.
Jupiter High School (two teams), Jupiter, Fla.
Lima Senior High School (two teams), Lima, Ohio
Madison County Career Technical Center (two teams), Huntsville, Ala.
Mayfield High School, Las Cruces, N.M.
Neerja Modi School, Jaipur, India
New Britain High School (two teams), New Britain, Conn.
Pana High School, Pana, Ill.
Pelham High School, Pelham, Ala.
Petra Mercado Bougart High School, Humacao, Puerto Rico
Plainfield High School, Plainfield, Ind.
San Andres High School, Mesilla, N.M.
Scotlandville Magnet High School (two teams), Baton Rouge, La.
South County Secondary School, Lorton, Va.
Teodoro Aguilar Mora Vocational High School (two teams), Yabucoa, Puerto Rico

Registered 2011 college/university teams

Alabama A & M University, Huntsville, Ala.
Bevill State Community College (two teams), Sumiton, Ala.
Cameron University, Lawton, Okla.
Carleton University, Ottawa, Ontario, Canada
Central Connecticut State University, New Britain, Conn.
Christian Brothers University (two teams), Memphis, Tenn.
Colorado School of Mines, Golden, Colo.
Fisk University, Nashville, Tenn.
Guru Tegh Bahadur Institute of Technology, New Delhi, India
Indira Gandhi Institute of Technology, Delhi, India
International Space Education Institute, Leipzig, Germany
Jaipur National University, Jaipur, India
Jijiga University, Jijiga, Ethiopia
JSS Academy of Technical Education, Noida, India
Middle Tennessee State University, Murfreesboro, Tenn.
Moscow Aviation University, Moscow, Russia
Mukesh Patel School of Technology, Mumbai, India
Netaji Subhas Institute of Technology, New Delhi, India
North Florida Community College, Madison, Fla.
Ohio State University (two teams), Columbus, Ohio
Pakistan Shipowners' Government College, Karachi, Pakistan
PEC University of Technology (two teams), Chandigarh, India
Pittsburg State University (two teams), Pittsburg, Kan.
Purdue University Calumet (two teams), Hammond, Ind.
Rajiv Gandhi Technical University, Bhopal, India
Rhode Island School of Design, Providence, R.I.
Ryerson University, Toronto, Ontario, Canada
Shree Ram Mulakh Institute of Engineering & Technology, Ambala, India
Southern Illinois University at Carbondale (two teams), Carbondale, Ill.
Tennessee Technological University, Cookeville, Tenn.
University of Alabama in Huntsville, Huntsville, Ala.
University of Central Florida (two teams), Orlando, Fla.
University of Chicago, Chicago, Ill.
University of Puerto Rico at Humacao, Puerto Rico
University of Utah, Salt Lake City, Utah
University of Wyoming, Laramie, Wyo.
Virginia Commonwealth University, Richmond, Va.
Youngstown State University, Youngstown, Ohio

that engineering tradition. Scheduled around a typical school year, the project begins Oct. 1, as teams organize, solicit sponsors, design their racing machines and begin construction. Each team may include up to six students and a teacher/mentor. High school students square off in one division; college and university teams compete in another.

Their challenge each year is to deliver a two-person, human-powered buggy, and to achieve the fastest vehicle assembly and race times, while avoiding penalties on a grueling, half-mile course of rock, gravel, sand and other materials which simulate the harsh lunar surface. Top prizes are awarded to the three teams in each division that finish fastest, with the fewest penalties.

Eight college teams participated in the first NASA Great Moonbuggy Race in Huntsville in 1994. The race was expanded in 1996 to include high school teams, and student participation has swelled each year since. Nearly 70 teams fielded moonbuggies in 2010.

The NASA Great Moonbuggy Race is organized annually by NASA's Marshall Space Flight Center in Huntsville. It has been hosted by the U.S. Space & Rocket Center since 1996.

The race is sponsored by the Space Operations Mission Directorate in Washington. Major corporate sponsors are Lockheed Martin Corporation, The Boeing Company, Northrop Grumman Corporation and Jacobs Engineering ESTS Group, all with operations in Huntsville. Other corporate and institutional contributors include ATK Aerospace Systems of Magna, Utah; the Huntsville operations of Science Applications International Corporation, Teledyne Brown Engineering, Davidson Technologies and Stanley Associates; and the American Institute of Aeronautics and Astronautics and the Tennessee Valley Chapter of the System Safety Society.

The NASA Great Moonbuggy Race is one of dozens of educational programs and initiatives the 10 NASA field centers implement each year to inspire and engage America's next generation of scientists, engineers and explorers -- those who will carry on the nation's mission of exploration and discovery in the decades to come.

The rules

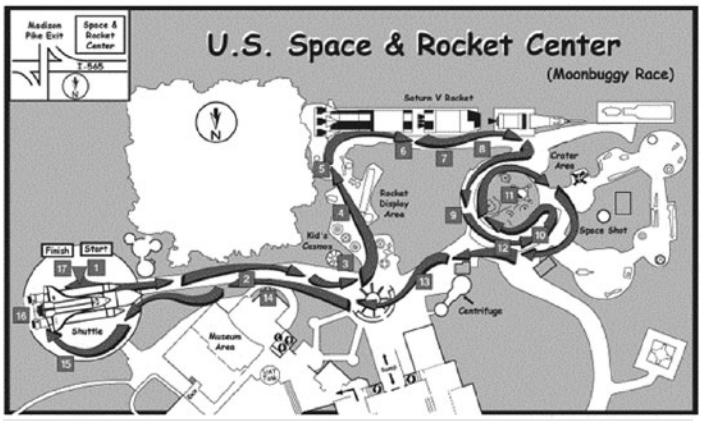
Teams selected as first-, second- and third-place winners in the high school and college divisions are judged based on the shortest total time to reconfigure their collapsed moonbuggies and complete the lunar obstacle course without incurring time penalties for various vehicle and course violations. Each team is permitted two runs of the course. The shortest total assembly, course and penalty time results in each team's final score.

Each vehicle must be solely human powered and propelled by two students -- one female and one male -- over the course. Every vehicle is required to have a specific set of lunar rover-style accessories: fenders, a flag and simulated batteries, communications antenna, radio and TV camera.

To reach the starting line, teams first must demonstrate that their folded or collapsed moonbuggies will fit into a 4-foot-by-4-foot-by-4-foot cubic container, similar to transport conditions experienced by the original lunar rovers during their journeys to the moon's surface in the Lunar Excursion Module. Folded moonbuggies next are lifted by the two drivers and carried 20 feet without touching the ground, demonstrating lightweight portability. The buggies then are assembled and readied for the course by the drivers, and evaluated for safety by the judges.

The buggies race against the clock, rather than side-by-side. Judges mark their progress, assessing penalty points if the drivers' hands or feet touch the ground, or if buggies lose onboard equipment. The drivers push hard to conquer each obstacle without overturning their machine or exceeding the 10-minute time limit on the course.

Some 350 members of the Marshall Center work force volunteer to assist with the moonbuggy race each year, maintaining safety at numerous busy spots on the race course and serving as timekeepers, vehicle inspectors, obstacle judges and crossing guards.



Course map

The NASA Great Moonbuggy Race course and specific obstacles vary slightly in detail from year to year. This outline gives participants a general idea of the course layout.

- The starting line is located under the space shuttle, near the "Pits" Area where moonbuggies are inspected and repaired. **Obstacle 1** is under the space shuttle.
- Next, the course slopes up slightly on a paved path that leads over a hill toward **Obstacle 2**, then travels downhill to **Obstacle 3**.
- A sharp turn to the left leads through the U.S Space & Rocket Center's rocket display area to **Obstacle 4** and **Obstacle 5**.
- The course turns sharply to the right, remaining on asphalt and moving uphill to **Obstacle 6**, **Obstacle 7** and **Obstacle 8**.
- At the end of this straight section, a sharp turn brings participants to **Obstacle 9** and **Obstacle 10**, on the circular downhill path leading to the lunar crater area.
- Entering the crater area, the course veers left. Racers must take a complete 360-degree clockwise path across the lunar terrain. The largest crater is **Obstacle 11**, with its challenging 18-inch uphill grade.
- Exiting the crater area, moonbuggies turn right toward **Obstacle 12**, **Obstacle 13** and **Obstacle 14**, on a path that starts flat, then slopes uphill. At the last of these obstacles, it slopes downward again. Speed bumps help slow descent.
- Finally, the course takes a left turn as racers enter the shuttle area and tackle **Obstacle 15**, **Obstacle 16** and **Obstacle 17** before proceeding to the finish line.

Racers from the University of Puerto Rico in Humacao won first place in the college division of the 17th annual NASA Great Moonbuggy Race in 2010. It is the only school to field a team every year since the competition's start in 1994. (MSFC/David Higginbotham)

The course

The U.S. Space & Rocket Center's maintenance and grounds crew spends two weeks prior to each year's competition preparing the simulated lunar course. It covers half a mile of cement patios and pathways that wind around the exterior of the popular Huntsville space museum and NASA Visitor Center, twining through an atmospheric backdrop of famous American rockets and space vehicles.

The course includes 17 unique obstacles built of plywood, aluminum and discarded tires. These obstacles and other portions of the course are enhanced with approximately 20 tons of gravel and 5 tons of sand. The material is carefully shaped to resemble craters, basins, ancient lava "rilles" and other obstacles found in the harsh lunar landscape.

The unearthly landscape of the current course was designed in 1993 by Dr. Larry Taylor, a lunar geologist and professor at the University of Tennessee at Knoxville; Dr. J.M. Wersinger, a physics professor at Auburn University in Auburn, Ala.; and the Marshall Center's Dr. Frank Six, now Marshall's university affairs officer supporting the annual race.

Safety is paramount on the challenging course. Every driver is required to wear a seatbelt during the race, and more than 175 hay bales line the drive path to protect speeding drivers and spectators alike.

The repairs tent

Student "pit crews" make use of NASA's buggy repairs tent throughout the competition, welding snapped struts, replacing bent wheels and installing new chains and sprockets. The tent includes work tables and benches, equipment and material supplies for crews working on up to six moonbuggies at a time.

Team members make their own repairs, with oversight and guidance provided by Marshall Center engineers. All pit crew members are required to wear safety glasses in the work area, and welds are supervised by trained professionals.

Repair tent equipment, provided by the Metals Engineering Branch of Marshall's Engineering Directorate, includes a variety of welding machines, hand tools, electric tools, duct tape and epoxy -- and a sizeable pile of salvaged scrap metal to replace or strengthen damaged vehicle parts. Also on hand are detailed maps of local bicycle shops and area hardware stores, in case repairs require additional tools or parts.

The prizes

Top prizes are awarded to the three teams in the high school division and three in the college division that post the best assembly-and-race times.

In the high school division, the first-place team receives a trophy from the Marshall Center and a one-week trip to the Advanced Space Academy at the Space & Rocket Center, courtesy of ATK Aerospace Systems. In the college and university division, the first-place team receives a trophy from the Marshall Center and $5,700 in cash from Northrop Grumman Inc., to support a trip to experience a launch at NASA's Kennedy Space Center, Fla.

Marshall also gives commemorative plaques to the second- and third-place teams in the high school and college divisions, and presents each team member of the top three teams in both divisions a medallion and certificate.

The Marshall Center's Engineering Directorate presents the Frank Joe Sexton Memorial Pit Crew Award plaque to the team whose engineering ingenuity, resourcefulness and teamwork most successfully overcomes race-day obstacles. Sexton, a NASA machinist, worked on the original lunar rover and numerous other space vehicles until his death in 2000. NASA also presents plaques for "Best Team Spirit" and "Featherweight." The latter award recognizes the team that designs the lightest, fastest buggy on the track.

Additional prizes for each division include a $1,000 cash award from the American Institute of Aeronautics and Astronautics for best moonbuggy design; an award for most improved team from Jacobs Engineering; and an award for fastest rookie team of the year from Northrop Grumman Corp. The American Institute of Aeronautics and Astronautics also awards a "Crash and Burn" plaque and cash prize to the college or university team that faces and resolves the most dramatic vehicle breakdown of the day's race. Every participating moonbuggy team receives a plaque from Science Applications International Corp.

For complete race rules and other official information, visit:
http://moonbuggy.msfc.nasa.gov

For high-resolution images and additional information about past races, visit:
http://www.nasa.gov/topics/moonmars/moonbuggy.html

For information about other NASA education programs, visit: **http://education.nasa.gov**

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George C. Marshall Space Flight Center
Huntsville, AL 35812
www.nasa.gov/marshall

www.nasa.gov

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